Composite based on resveratrol and selenium as an antioxidative component in tissue engineering

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INTRODUCTION: Inflammation and oxidative stress are common problems in biomaterial science. Therefore, antioxidative components, especially those of natural origin, can be of great value in improving biomaterial formulations for medical devices [1]. It is already well known that the most notable exogenous antioxidants are ascorbic acid, polyphenolic compounds, and minerals such as selenium and zinc [2]. In our research, we prepared a composite based on polyphenolic resveratrol nanobelts and selenium nanoparticles and explored its' antioxidative potential.

EXPERIMENTAL: Resveratrol and selenium-based composite (ResSeNPs) was made by combining pre-synthesized resveratrol nanobelt-like particles (ResNPs) [3] and selenium nanoparticles (SeNPs) [4], using high-speed homogenization. The suspension was characterized by using OPTICA B-500MET light microscope (Optica SRL, Italy) and Nicolet iS10 FT-IR Spectrometer (Thermo Fisher, USA). The antioxidative effect was assessed by DPPH reduction assay, Ferric cyanide (Fe^{3+}) reducing antioxidant power assay (FRAP) for measuring of iron ion reduction, and thiobarbituric acid assay for assessment of inhibition of lipid peroxidation. All experiments were done in triplicate and average values calculated, followed by student's t-test for statistical significance compared to the controls, with threshold being set to $*p<0.05$.

RESULTS AND DISCUSSION: The obtained ResSeNPs composite was bright orange, homogenous, and stable. Agglomerates of SeNPs were seen around ResNPs on the optical microscope. FTIR spectroscopy showed the appearance of new hydrogen bonds, most possibly formed between ResNPs and the surfactant component of SeNPs, which was bovine serum albumin. ResSeNPs exhibited significant free radical reduction (over 80 % reduction at all tested concentrations), up to 80 % inhibition of lipid peroxidation, and in FRAP assay it reduced iron up to significantly high $A_{700} = 6.63$, at the highest tested concentration (1.5 vol.% in the solution).

CONCLUSIONS: ResSeNPs composite, consisting of ResNPs and SeNPs bonded by hydrogen bonds, exhibited notable antioxidative activity by various mechanisms of action - radical scavenging, lipid peroxidation-inhibitory effect, and reduction of ferric ions, even at very low concentrations. These findings highlighted the significant potential of ResSeNPs as an antioxidative component in further material design.

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